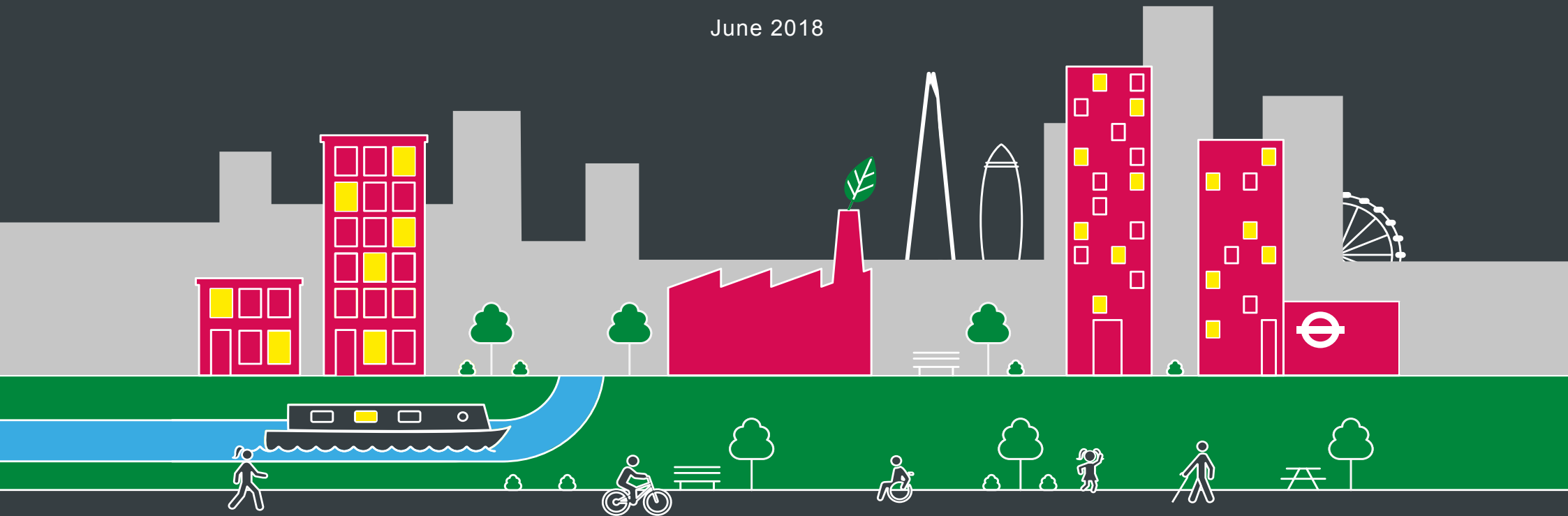


OPDC
OLD OAK AND
PARK ROYAL
DEVELOPMENT
CORPORATION

Waste in Tall Buildings Study

LOCAL PLAN SUPPORTING STUDY

June 2018



MAYOR OF LONDON

58. Waste in Tall Buildings Study

Document Title	Waste in Tall Buildings Study
Lead Author	Eunomia
Purpose of the Study	<ul style="list-style-type: none">• To identify the issues and challenges of meeting the Mayor's waste recycling standards in dense urban development.• To provide guidance on the best approach to meet these standards in tall buildings/high density development that will support the development of a Supplementary Planning Document (SPD).
Key outputs	<ul style="list-style-type: none">• Guidance for developers on designing waste infrastructure and waste management systems to support achievement of the Mayor's waste targets in tall buildings/high density development• Set of principles for high performing recycling systems in residential and commercial (mixed use) development• Principles for good user engagement• A review of different waste management strategy options and infrastructure and their role in supporting waste management in tall buildings• Guidance on calculating residential and commercial waste arisings in tall buildings/high density development.• Recommended guidance for inclusion in a waste SPD
Key recommendations	<ul style="list-style-type: none">• Waste management and recycling in tall buildings is very challenging. On average waste recycling in tall buildings is 50% less than from housing.• Developers must adopt and demonstrate positive approaches to waste management and ensure that adequate space and infrastructure is provided to support recycling and waste management.• Space to store 3 waste streams in homes and waste collection points must be provided.• Waste storage bins throughout the development should follow the same colour coding, be clearly sign-posted and easily accessible.• Active management and engagement by facility managers is likely to be required especially in tall buildings• Residents should be supported when they first move into a development so they understand how to use the waste system.• Innovation including for example smart bins, smart controls to chutes and bin stores, smart bins, good clear signage, compaction, in-vessel composting etc. can help improve recycling rates, support better use of waste facilities, reduce space take and optimise collection.• Space for bulky waste, commercial waste and other non-standard waste streams should be provided.• Waste disposal points in public spaces should be as close to residential development as possible and ideally no further than 30m from the front door.• Waste collection points must be accessible by the Local Authority or collection company and ideally no further than 10ms from a road that is accessible by truck.

Key changes made since Reg 19 (1)	N/A - New study
Relations to other studies	Outputs cross relate to the Utilities Study and Waste Management Strategy.
Relevant Local Plan Policies and Chapters	<ul style="list-style-type: none"> • Policy SP10 (Integrated Delivery) • Chapter 5 – Design Policy D2 (Public Realm) and D4 (Well Designed Buildings) • Chapter 6 – Environment and Utilities Policy EU6 (Waste Management)

11th June 2018
v1.0

Waste in Tall Buildings Study

Final Report for OPDC

Authors:
James Fulford
Amy Slack
Rob Gillies



**Report for Old Oak & Park Royal
Development Corporation**

Prepared by:

Amy Slack
Rob Gillies
James Fulford

Approved by:

James Fulford
(Project Director)

Address:

Eunomia Research & Consulting Ltd
37 Queen Square
Bristol
BS1 4QS
United Kingdom

Tel:

+44 (0)117 9172250

Fax:

+44 (0)8717 142942

Web:

www.eunomia.co.uk

Disclaimer:

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Glossary

Term	Definition
AD	Anaerobic Digestion. Food waste used to produce digestate and biogas which is converted to electricity.
Bin Store	Central location where material from communal properties is deposited prior to transportation for treatment/disposal.
Bulk Density	The weight of material in a given volume. kg/m ³ or kg/L commonly used for waste bulk density.
Bulking	Consolidation of collected material in a central location (depot or waste transfer station) prior to onward transportation for treatment or disposal.
Bulky Waste	Waste types which are too large to be accepted by the regular waste collection service (e.g. mattresses, furniture).
Communal Waste Arisings	Volume of waste generated by residential properties where waste and recycling services are provided from a communal location (instead of individual self-contained properties).
Contamination (recycling)	Materials within a specific recycling container/ collection which cannot be recycled in that stream. For example – plastic wrappers in a separate food bin, or glass in a paper recycling bin.

Term	Definition
Dry Recycling	Can include aluminium, steel, plastics, glass, card and paper. Material can be collected as separate material streams or in combination.
DMR	Dry mixed recycling. A combination of dry recycling materials. This can include aluminium, steel, plastics, glass, card and paper.
FWD	Food Waste Disposers.
GLA	Greater London Authority.
IVC	In-Vessel Composting. Food and garden waste processed to produce a compost-like output soil improver.
LACW	Local Authority Collected Waste.
London's Environment Strategy	Strategy setting out the vision for London's environment in 2050. The strategy includes a target of 65% of London's MSW to be recycled by 2050. <u>Summary available:</u> https://www.london.gov.uk/sites/default/files/draft_environment_strategy_-_executive_summary.pdf

Term	Definition
Material composition	The composition (type and percentage) of material present in a waste stream.
MI	Management Information.
Multi-channel Communication Programmes	The practice of interacting with users in a combination of indirect and direct communication channels.
Municipal Solid Waste / MSW	Black bagged waste and bulky waste. Material collected by local authorities and commercially. It does not include municipal construction and demolition waste.
OPDC	Old Oak and Park Royal Development Corporation.
Recycling	The reprocessing of materials to re-useable material. Recyclable materials from households and commercial properties can include aluminium, steel, plastics, card, glass, paper and food.
Recycling Rate/ Recycling Performance	The proportion of recyclable material separately collection from MSW/black bag waste.
Recycling Scheme	The method of collecting recycling which the user has separated into specific containers from MSW.

Term	Definition
Residual Waste	Black bag waste/MSW.
Three-stream Segregation	An approach to recycling where materials are split into three streams: – Stream 1: DMR; Stream 2: food waste; and Stream 3: residual waste.
Waste Arisings	Total volume of waste from a source (e.g. households, commercial premises).
Waste Management Service	A service that provides waste/recycling collection, recycling, recovery and disposal.
WCA	Waste Collection Authority. Local Government splits responsibility for managing waste between two types of authority. London Borough are typically Waste Collection Authorities (this is the case in LB Hammersmith & Fulham and LB Ealing) but separate Waste Disposal Authorities manage the waste for multiple WCAs once it is collected.
WDA	Waste Disposal Authority. See WCA above.
WEEE	Waste Electrical and Electronic Equipment.
WRAP	Waste and Resources Action Programme.

1.0 Introduction

The Old Oak and Park Royal Development Corporation (OPDC) is committed to delivering a development that can meet the Mayor of London's Environment Strategy targets of recycling 50% of Local Authority Collected Waste (LACW) by 2025 and 65% of Municipal Solid Waste (comprising LACW and commercially-collected waste) by 2030. These are challenging targets for London as a whole, but in medium and high rise, high density housing and mixed-use developments where recycling rates are on average half that achieved for low rise, low density housing, they are even more difficult to achieve.

...introduction cont...

The Old Oak and Park Royal development will be a phased, mixed use development consisting of an anticipated total of 26,523 residential units and over 1.1 million meters squared of commercial and industrial space once the development is complete. Based on London residential communal waste arising information, it is anticipated that approximately 17,452 tonnes of household waste will be produced per annum. There will also be a considerable quantity of commercial waste arising across the development for which provision must be included¹. Given the scale of waste arising, developers are required to carefully consider the provision of waste management across the development that will enable the development to meet the targets set out in London's Environment Strategy.

The information within this document is intended to guide and support developers putting forward proposals for the Old Oak and Park Royal development in the design of good practice waste management systems that will encourage high levels of recycling performance by building users.

¹ — The quantity of commercial waste that will be produced can only be calculated once the number and type of businesses that will be based in the development is known. This is discussed in Section 4.0.

1.1 Guidance Scope

These guidelines cover waste management provision within the building envelope, for communally managed residential waste and commercial waste arising from high-density mixed-use development. Guidelines on waste collection from buildings serviced as individual self-contained properties (often referred to as 'kerbside collection buildings') are not included. Onward bulking and transfer, and waste treatment and disposal infrastructure are not included within the scope for this study. Public waste management (e.g. litter) is also not covered by these guidelines.

1.2 Using These Guidelines to Support Planning Applications

These guidelines are set out in such a way as to provide information for developers on:

- The challenges of achieving high levels of recycling performance in high density developments;
- OPDC's waste management provision requirements that all developers must meet; and
- A range of potential waste management strategies, OPDC's requirements for adoptions, and options to enable the goal of high recycling performance.

Developers are encouraged to use these guidelines to inform the waste management strategies proposed in their planning submissions. Submissions should demonstrate how these guidelines have been used to influence the waste management solutions presented. Emphasis should be given as to how the solutions proposed will facilitate the achievement of the London Mayor's recycling targets.

Users of these guidelines are also invited to refer to the reference documents listed in Section 5.0 for additional information and further detail.

2.0

Achieving High Recycling Performance Across Old Oak and Park Royal

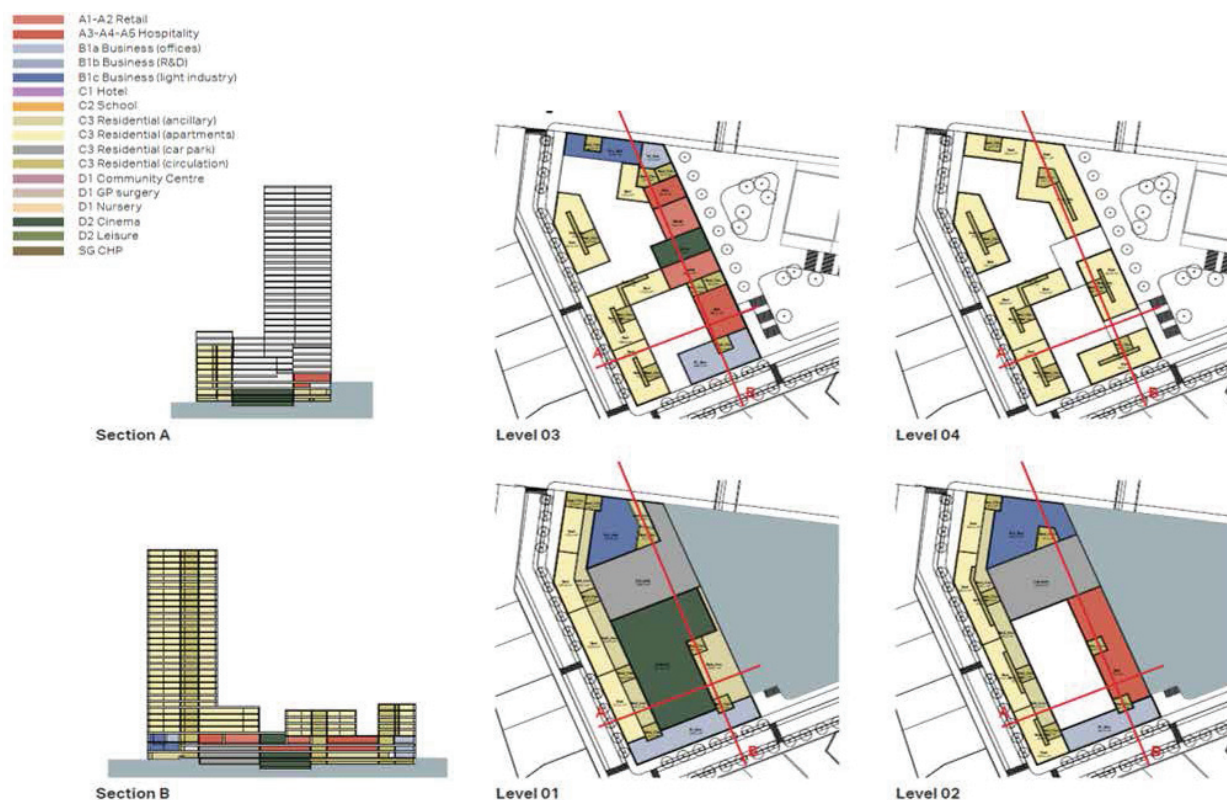
2.1.1 OPDC Building Typology

Figure 2.1 presents an indicative high density development plot, highlighting the challenges associated with the provision of waste management in high density developments. The high-density nature of the Old Oak and Park Royal development with multiple high-rise blocks (see section A of Figure 2.1) will require sufficient waste storage capacity to be provided for within limited and competing space both within the building envelope and public realm. This is further complicated by the mixed-use nature of the development (see levels 01–03 in Figure 2.1).

There are few cases across the development where one block is allocated exclusively to one use (e.g. residential). The nature of the waste generated varies significantly between residential and commercial use as does the mechanisms for collections (i.e. private charged waste collection for commercial waste, free public waste collection for residential). Sufficient facilities and space therefore needs to be provided to allow for the contrasting requirements of each use type.

Furthermore, the topography of the development presents an additional challenge. The split-level nature of the master plan is likely to require waste infrastructure provision across multiple levels depending on residential and commercial access and location at podium level or centred around the building core at upper levels.

Figure 2.1: Example Building Typology



2.2

Principles for High Performing Recycling Systems

Research conducted for the Waste and Resources Action Programme (WRAP)² on the common characteristics of high performing recycling schemes in dense urban environments from around the world identified eleven common characteristics and principles (regardless of building typology and waste management systems/technologies involved). Developers are required to demonstrate that their plans for waste share these characteristics:

1. Adequate space in a convenient location within dwelling / business units to allow for separation and storage (for a convenient period) of a wide range of dry recycling and food waste from residual waste;
2. Adequate space within the building or in a convenient near-access location for separate containment for storage and collections in a ratio that maximises recycling for both residential and commercial uses;
3. A system that encourages a sense of personal responsibility for correct segregation of waste and use of waste management service/infrastructure. This could include linking use of service to individual, household, or business via technology (e.g. smart bins) and/or monitoring (via CCTV and caretaking staff).
4. Building caretaker(s) with a clear waste management role, including for engaging with residents to encourage good recycling behaviours and use of system.
5. Positive visual amenity i.e. tidy and clean waste management areas, absence of spillages or uncontained waste around and within bins and bin stores etc.
6. Provision of multi-channel communications programmes and signage for commercial and residential use to inform users about the waste management service and its use and encourage desired recycling behaviours.
7. Communications and signage for residential use should be able to be easily understood by different nationalities with varying proficiency in the English language;
8. Freehold/leasehold and rental conditions that include clear obligations on commercial tenant/resident to use waste management facilities in the correct way;
9. In-building waste management and storage solutions that are well integrated with the collection system in use. Developers should be mindful that local authority collection systems may change over time as new collection contracts are let or in response to changing legislation. Systems that rely on hard infrastructure may not be resilient to these types of change.
10. Provision for deposit of residential bulky items for preparation for re-use or recycling in a convenient location;
11. Solutions that facilitate the collection and reporting of Management Information (MI) on the amount and type of waste generated by waste stream so that this MI can be used to identify performance issues and evaluate impacts of additional interventions for both commercial and residential use.

² — Research undertaken by Eunomia Research & Consulting on behalf of WRAP. Unpublished work.

2.3 User Engagement

The way users engage with and use the system is a key consideration in the design of an effective waste management service and will have a significant impact on recycling performance. This issue is complicated in medium and high-rise developments, where users suffer less direct consequence if they misuse systems than is the case in other types of housing. For example, if a resident living in a low-rise house contaminates their personal recycling bin with refuse (intentionally or unintentionally), it is likely that the bin would not be collected and the resident would have to remove the contamination and arrange another collection (or cope until their next collection). The perceived inconvenience that follows from misusing the system reinforces positive recycling behaviours. However, in medium and high-rise developments, the anonymity associated with the use of communal systems changes this dynamic considerably.

When incorporating waste management systems within high density medium and high-rise developments the following user engagement issues should be considered (examples of good and bad practice can be found in A.1.0):

User Instructions

Users need to be clearly informed as to how to use the service that is provided. This includes what waste materials go where and how they should be presented. Instructions should be made available within the residential unit and made available to any new residents. Depending on the waste management arrangements, user instructions may need to be tailored 'block by block' and include details of:

- + *The location of bin store areas/chutes etc. (potentially including a map of the location of the bin store if it is located outside of the building / within a service area;*
- + *Materials that are accepted and not accepted in each type of bin;*
- + *Any keys or codes needed to access these; and*
- + *Arrangements in place for depositing of any bulky waste.*

Signage and Iconography

Signage in and around container storage areas and also within residential buildings should comply with the Recycle for London campaign, supported by the GLA. This tried and tested campaign underpins nearly all household communications across London, with its style and iconography being widely recognised. The Recycle for London (RfL) brand guidelines were refreshed in 2015 alongside the national Recycle Now Campaign and provide an element of flexibility in how these can be used and applied. Artwork and images can also be freely downloaded and used for the Recycle Now Partners website allowing the cost-effective development of signage. Developers should work alongside the relevant local authority to ensure that any signage complies with borough or area based campaigns. As a minimum all signs should be:

- + *Constructed from a durable material such as metal or hard plastic, to ensure that they remain in good and readable condition over time.*
- + *Be clear and, where possible, use icons and images rather than lots of words (English may not be the first language for some residents);*
- + *Be appropriately located e.g. on or above waste/recycling containers, on the door of a container storage area etc.*
- + *If a food waste system is being introduced, consistent signage & 'no food waste please' stickers/signs should also be placed on all refuse containers.*

Figure 2 2: Recycle Now Iconography



New resident engagement

To ensure the waste and recycling systems are used effectively all new residents need to know how to use the system. The challenge facing developers is that in some cases properties are handed to an owner who may live in or rent the property and in other cases this may be a housing provider. Therefore, it is important to consider how best to engage with each group of residents. As a minimum the following should be provided:

- + *Clear user instruction provided with a resident welcome pack (in alternative languages where appropriate);*
- + *Clear posters and signage close to waste deposit and storage areas (including chutes where applicable), within hallways, communal areas, and lifts;*
- + *Clear user instructions on the property website (if applicable); and*
- + *Engagement from site management / facilities management staff.*

Enforcement

As well as any scheme is designed, there will inevitably be issues with usage by residents (both accidental and deliberate). This can result in contamination of recycling and/or loss of recyclable materials within the residual waste stream. The cost to the developer/management company and the local authority of providing additional collections to empty overfilling containers or clearing domestic fly tips can be considerable. Therefore, developers/site management should:

- + *Engage with the relevant local authority to ensure that the right processes are in place to support the effective enforcement of the service. This may include investigation of flytips etc. or segregation of waste for inspection by a trained officer.*
- + *Ensure compliance with the waste management system provided. Correct segregation of waste and recycling materials should be included as a specific condition of any lease, sub-lease or tenancy agreement. It should be made clear that failure to comply will represent a breach of the lease of the property. It may also be possible to add charges incurred for contamination to the management fee as an option for enforcement.*

Smart Technology

Smart bin technology such as access fobs and electronic data recording systems are increasingly considered in high density development to support waste management. Whilst relatively new, there is potential to improve performance through monitoring of non-compliance to aid communication and resident engagement. Bin fill sensors can also be used to improve waste collection efficiency. Developers and management should consider the following:

- + *Smart bin technology is generally easier to install during initial development than to retrofit, and user guidance and information is also generally easier to convey to residents as they move into a new development as opposed to communicating the introduction of smart bin technology once a resident community is established.*
- + *The complexity of a system for users, needs to be considered, especially where resident turnover may be high. Provision of information and guidance for new residents (who are likely to be unfamiliar with new types of bin technology) will also need to be considered.*
- + *It is not sufficient to specify, purchase and install technology. To be effective, there needs to be a clear strategy for how this technology will be monitored and used. For example, facilities management staff should have a clear remit to use information to inform communication campaigns and there should be clarity regarding where the funding to support*

3.0

Waste Management Strategy Options – Residential

3.1 Maximising Separation for Recycling in the Home

To facilitate segregation of dry recycling and food waste from residual (non-recyclable) waste within the home, sufficient home bin infrastructure should be provided within all residential units (regardless of building type e.g. low-rise, high-rise).

As standard provision should encompass:

- A three-bin system within the kitchen (Dry Mixed Recycling (DMR), Food, Residual)
- A two -bin system within the bathroom (DMR and residual)

Table 3.1 sets out the minimum required bin volumes that should be provided within the kitchen of each home. This is based on the provision of waste storage that encourages recycling and a minimum of three days waste storage. Where kitchen design prevents sufficient volume of integrated bin units to be provided, an equivalent volume of free-standing bin provision should be provided.

Food waste bins are to be of a design which allows resident to easily remove and clean the bin and to transfer food waste from the home to the communal food waste deposit point.

Table 3.1: In Home Bin Volume Guide

	1–3 Bedroom Household (l)	4+ Bedroom Household (l)
Mixed Dry Recycling	25	30
Food Waste	5	5
Residual Waste	25	30

Bins must be colour coded, following OPDC waste management colour scheme. It is intended that OPDC will follow guidance on colour schemes suggested by WRAP through its Framework for Greater Consistency in Recycling in England. At the time of writing, this was undergoing a consultation process. This guidance will be updated once WRAP's guidelines have been finalised.

Food Waste Disposers (FWD), or macerators, are units attached to sinks that grind or macerate food waste into small pieces, which are washed or flushed into the sewer system. At the waste water treatment plant, organic waste is separated out and is treated, usually through Anaerobic Digestion (AD). Whilst maceration could theoretically improve levels of food waste recycling by making it considerably easier, it can place significant strain on existing water and sewage networks³. Water and sewage arising from the Old Oak and Park Royal development will feed into the Counter Creek water and sewage network which is already at capacity. OPDC are required to minimise release to this network and therefore require FWD to be excluded from all new developments.

The direction of legislation on FWD's should also be noted. In Scotland the use of FWDs has been banned for non-domestic use. On 1st January 2016 legislation came into effect that meant that all businesses producing more than 5kg of food waste per week are required to present it for recycling. FWDs cannot be used except where the business is particularly rural. Welsh Government is also investigating the possible introduction of a commercial food waste to sewer ban.

There are no plans for these bans to be extended to cover domestic waste, nor for bans to be introduced in England. However, the existing bans have been introduced in

3 — WRC (2010) – National Food Waste Programme – Comparison of the Sustainability of Food Waste Disposal Options.

3.2 Building Infrastructure

Developers are required to adopt a comprehensive waste management system for the transfer of waste from the home to a central deposit point which meet OPDC's principles for high performance recycling set out in section 2.1.1. Developers are required to demonstrate how the adopted system will meet OPDC's requirements for achieving high recycling performance as set out in section 2.0⁴.

As described above, building infrastructure alone is unlikely to result in high performing waste management and developers are required to consider how infrastructure installed can be combined with good user engagement practices to enable high recycling systems.

3.2.1

Infrastructure Options

The following section sets out OPDC's overarching requirements that developers should meet for provision of waste and recycling facilities across Old Oak and Park Royal. The main infrastructure system options that OPDC consider appropriate for a development of this nature are briefly described along with an overview of the advantages and disadvantages of each system. OPDC's requirements for adoption are outlined along with options developers may consider to further enhance the system.

3.2.1.1

Overarching Requirements

OPDC require developers to adopt a waste management infrastructure solution that:

- Accommodates diversion from residual waste via a three-stream system of separation consisting of:
- Dry Mixed Recycling (DMR) including plastic bottles, pots, tubs and trays, metal containers, cartons, glass containers, paper and card;
- Food Waste⁵; and
- Residual Waste i.e. waste that can't be recycled by the local authority, including non-recyclable packaging and other waste.
- Residents should not be required to carry waste more than 30m (excluding vertical distance)⁶.

- Waste containers should be stored within 25m of the collection point specified by the waste collection authority at which its vehicles will park up, this being the maximum bin 'pull' distance which bins will be moved by the authorities' collection staff⁷.
- Movement of waste between the home and point of deposit should be facilitated to avoid spills and odour release. Effectively this means that allowance should be made for good containers to assist residents in carrying the waste and recyclables.

4 — Any waste management strategy proposed must conform to all relevant Health & Safety obligations and standards, including the British Standard Code of Practice for Waste Management in Buildings.

5 — At the time of writing, food waste is collected by LB Brent and LB Ealing. No food waste collection is offered by LB Hammersmith & Fulham. Through consultation with the authority, it is agreed that facilities to allow food waste collection should be assumed in order to ensure the development is future proofed.

6 — Building Regulations 2010 H6: Drainage and Waste Disposal: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/442889/BR_PDF_AD_H_2015.pdf

7 — Building Regulations 2010 H6: Drainage and Waste Disposal: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/442889/BR_PDF_AD_H_2015.pdf

3.2.1.2

Communal Bin Store

Communal bin stores are very widely used in developments of this type. Residents are responsible for transferring recycling and waste from home to a communal bin store located at podium level or within a basement level area. Where the bin store is located more than 10m from an adopted highway, site caretaking staff manoeuvre bins to collection point agreed with the WCA. For bin stores within 10m of an adopted highway, the WCA collect directly from the bin store (where there is restricted access, WCA will need access rights).

Development Requirements if Adopted

Number and size of bins to be provided according to guidance in 3.2.2.

- Bin store to be sited in a convenient location to allow for residents to easily access on the way in and out of the building as part of normal day to day activity (i.e. avoid locating where residents have to make a special trip where possible).
- Siting to consider mitigation of noise and odour issues for residents.
- Controlled access to bin store helps to prevent use of bins by non-residents, fly tipping etc. Use of ID card/tag access, especially if linked to individual household 'account' will allow for metrics to be gathered on usage etc. for use in targeted education / enforcement activity.
- Appropriate extractive ventilation to be installed to manage odour issues.
- Bin store area to be kept clear and clean to minimise misuse and dumping of unsorted waste.

Good Practice

At this development in Hackney, communal bins make clear use of signage with sufficient storage capacity for each waste stream. This allows easy use of facilities and limits issues with contamination. *Image Source: WRAP Recycling Now*



Poor Practice

The layout and management of this communal bin store in Hounslow is poor with no clear signage or instructions. Combined with insufficient storage capacity this results in high levels of contamination of the recycling streams and disposal of recyclables in refuse streams. *Image Source: Eunomia Research & Consulting*



	Advantages	Disadvantages
Technical Complexity	<ul style="list-style-type: none"> Conventional system, therefore familiar to most residents. 	
Land Take	<ul style="list-style-type: none"> Greater flexibility to reconfigure as required to accommodate changes in waste collection and material range. 	<ul style="list-style-type: none"> A significant amount of land take is required to provide adequate storage space for this option.
Impact on WCA	<ul style="list-style-type: none"> Compatible with existing WCA collection system. 	<ul style="list-style-type: none"> If controlled access to bin store, there is a risk that collection crews are unable to gain access where they are collecting bins directly from storage area. It is not realistic to assume that keys or codes will be reliably carried, nor that the same crew or vehicle will collect the bins on each occasion.
Capital and Operational Costs	<ul style="list-style-type: none"> Relatively low initial implementation cost. Costs well known. Relatively little caretaking staff time required to manage (possibly none, depending on collection arrangements). 	<ul style="list-style-type: none"> Depending on number of bins and design and location of bin store and collection arrangements, significant time requirement for caretaking staff in transferring and returning bins to/from collection point and keeping area and bins clean. Health and safety risk from need to manoeuvre large number of heavy bulk bins between storage area and collection point. Large number of bulk bins being moved across public realm for collection and being left in designated collection points can pose risk to pedestrians and traffic.
Maximising Recycling		<ul style="list-style-type: none"> Conventional system which reflects majority of traditional high density residential provision from which high recycling performance is rare. Relies on residents to transfer recycling and waste from home to external storage area and deposit in correct communal bins. Location of bin store is important to maximise convenience for residents to be able to deposit material on way to / from usual daily routes. Difficult to control for residents placing wrong materials in wrong containers leading to contamination of DMR bins with residual and food waste and food waste and recyclables being placed in residual bins. Leading to lower recycling performance and potentially additional cost to WCA from DMR loads being rejected from re-processing process. Lack of ownership for individual residents / households due to communal nature of bin provision. Risk that over time good recycling behaviour 'loses out' to bad. Where DMR bins become full DMR likely to be put in residual bins leading to lower recycling performance. Unless intensively monitored and regularly kept clean, can be subject waste spills within or near storage area and attract additional small-scale dumping / fly-tipping and vermin with negative visual amenity impacts.
Future Proof	<ul style="list-style-type: none"> Flexible for future changes in waste segregation policy and easy to adjust number, types and ratio of bins depending on resident numbers and performance. 	

System Options	Description	Relative Merits	Requirements
Bin Compaction	Bin compactors located within each bin store operated by facilities management are used to reduce the volume of waste within a wheeled bin. These are generally small fixed units located within the bin store area.	<p>Reduces the number of bins and subsequent space required for waste management across the development.</p> <p>Space requirements are typically 1.5–1.75x wheeled bin footprint (excluding any additional space required for confinement).</p>	<p>Bin compactors to be inaccessible to residents e.g. locked cage.</p> <p>Compaction ratios of no greater than 1:2 for recycling and 1:4 for refuse to be used. Food waste should not be compacted.</p> <p>Sufficiently trained facilities manager required to ensure system is properly and safely used.</p>
Skip Compactors	Wheeled bins are transported to a central collection point where material is transferred to a compactor skip unit by facilities management staff.	<p>Potential to significantly reduce number of bins required and subsequent storage within each building but would require additional central stage facility and alternative collection vehicles.</p>	<p>Additional central waste storage facility with sufficient space to accommodate at least one week's waste storage.</p> <p>Compaction ratios of no greater than 1:2 for recycling and 1:4 for refuse to be used. Food waste should not be compacted.</p> <p>Sufficient facilities management staff to manage transfer of wheeled bin.</p>
Bin-fill telemetry	Bin fill sensors can be fitted to monitor when a wheeled bin is full and requires collection.	<p>This can have some benefit to facilities management to monitor specific misuse issues. Where appropriate, full bins can be secured when full to prevent overflow.</p> <p>Can be used to inform WCA of collection needs where direct collection bin stores.</p> <p>These systems are expensive and can be installed without being well used. It is much easier to manage crews to operate standard rather than flexible rounds.</p>	<p>Bin sensors adequately fixed to avoid issues with sensors being dislodged. Good integration with staff and systems at the next stage in the collection cycle is essential to realise the potential value in this system.</p>
CCTV Instillation	CCTV system can be used (and publicised) to monitor residents' use of bins, correct segregation of waste, controlling for dumping of waste etc.	<p>Can be used as an effective monitoring and enforcement tool but required considerable facilities management investment</p>	

3.2.1.3

Gravity Chute System

Gravity chutes are intended to make it easier for residents to dispose of waste and recycling. Residents are responsible for depositing residual/DMR/food waste into a chute system via a hopper in a hall-way on the same level as their residence. Unlike traditional refuse-only chute systems, modern systems can be designed to support three-stream segregation. Waste is collected and stored at the base of the chute either at podium level or basement level within wheeled bins. Bulk bin storage areas are not typically accessible to residents. Facilities managers are responsible for monitoring and managing waste, including switching wheeled bins over when full. Bin are moved by facilities management staff to collection point.

Development Requirements if Adopted

- A one chute system with separation units at the base of the chute is preferred to minimise impact on void space required to accommodate the chute system. However, a multi-chute system may be considered where there is strong justification to do so.
- The chute system must accommodate three-stream segregation at the base of the chute. Waste deposited in chute system will exit into appropriate bulk bins beneath chute opening (controlled by resident waste type selection at access point).
- Clear and easy to understand signage and colour-coding should be used to indicate how to deposit different waste streams.
- Consideration must be given to system design to minimise deposit of waste around chutes hoppers.
- Design should minimise risk of blockages and have system for identifying and clearing blockages quickly and efficiently. Trained facilities management staff will need to be available to clear blocked

hoppers promptly.

- Consideration in system design to reduce risk of glass breakage within DMR and subsequent issues with mechanical sorting of DMR and health and safety risks.
- Appropriate extractive ventilation to be installed to manage odour issues within the chute and storage area.
- Chute design should comply with British Standard BS 1703 (Specification for Refuse Chutes and Hoppers).
- Chutes should be equipped with shutters to avoid risk of injury to caretaking staff when replacing bins at bottom of chute.
- Chutes should fall vertically without slopes or bends, with bin stores directly beneath each chute.

Good Practice

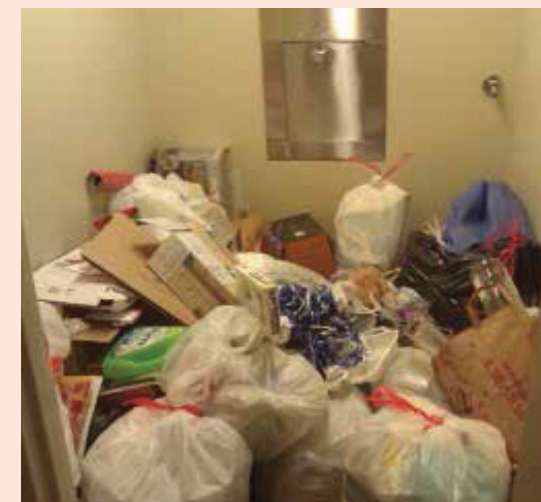
This chute system at Battersea Reach, London has a clear control panel to enable the disposal of different waste streams, although labelling could be improved. The 'protected lobby space' with sloping floor aims to discourage dumping of waste around the chute. User instructions are clearly provided above the hopper. A separation facility at the base of the chute directs waste into the correct bin. *Image Source: Left image – Eunomia Research & Consulting; Right image, Hardall.co.uk*



Poor Practice

This chute system had become blocked resulting in deposits of waste around the chute hoppers. There is also a lack of clear instruction of signage and instruction on how to use the system with only one material stream being catered for.

Image Source: Reddit



	Advantages	Disadvantages
Technical Complexity		<ul style="list-style-type: none"> • Chutes can and regularly do become blocked and will require monitoring and unblocking using approved method. • Chute electronics will need regular servicing and ad-hoc repair to correct faults. • Large number of bulk bins being moved across public realm for collection and being left in designated collection points can pose risk to pedestrians and traffic.
Land Take	<ul style="list-style-type: none"> • Relatively less space impact compared to communal bin store system. • The collection points are very conveniently positioned for residents, especially in tall buildings, and avoid the need to carry waste which can smell in lifts. 	<ul style="list-style-type: none"> • Requires space allocation within the building core including potentially a chute collection space and a second central waste area from which the WCA will collect.
Capital and Operational Costs		<ul style="list-style-type: none"> • Approximately £6,000 capital cost per floor plus additional maintenance costs • Depending on number of bins and design and location of bin store at bottom of chute, significant time requirement for caretaking staff in transferring and returning bins to/from collection point and keeping area and bins clean. Potential for double handling. • Health and safety risk from need to manoeuvre large number of heavy bulk bins between storage area and collection point.
Maximising Recycling	<ul style="list-style-type: none"> • Convenient to use as point of deposit for residents. • Minimises distance residents are required to travel with waste. • Minimises potential for waste leakage in communal areas e.g. lifts and corridors and possible related odour issues. • Relatively clean and tidy environment for residents as bins are hidden within service area. • Automatic waste stream separation can be designed to make contamination of dry recycling stream with residual or food waste more difficult as user required to make conscious choice to select recycling when accessing chute. 	<ul style="list-style-type: none"> • Blocked chutes may lead to waste being dumped within or outside chute access points. Good chute design to avoid blockages is critical for successful operation. • Without smart automatic chute separation system it can be difficult to control for residents incorrectly segregating and depositing waste and recycling in chute. • Relatively difficult to identify residents misusing system / contaminating DMR. • Waste is invisible to residents once deposited, meaning less visual nudge into waste prevention behaviours compared to when being faced with volume produced by self and neighbours. • Unless intensively monitored and regularly kept clean, can be subject to waste spills within or near chute access points and attract additional small-scale dumping.
Future Proof	<ul style="list-style-type: none"> • Can incorporate smart technology solutions such as bin fill telemetry, and tractability solutions 	<ul style="list-style-type: none"> • Limited ability to adapt to future changes in waste service and greater separation of waste.

System Options	Description	Relative Merits	Requirements
Skip Compactors	Bulk bins are transported to a central collection point where material is transferred to a compactor skip unit by facilities management staff.	Potential to significantly reduce number of bins required and subsequent storage within each building but would require additional central stage facility and alternative collection vehicles.	<p>Additional central waste storage facility with sufficient space to accommodate at least one week's waste storage.</p> <p>Compaction ratios of no greater than 1:2 for recycling and 1:4 for refuse to be used. Food waste should not be compacted.</p> <p>Sufficient facilities management role to manage transfer of wheeled bin.</p>
Integration with Automated Waste Collection System	Modern chutes system are able to be linked to a vacuum waste system where this is available. Chutes and vacuum stems are already linked within a number of developments including new systems installed at Wembley Park in London.	<p>Reduces the requirement for bulk bin storage capacity therefore reducing likely space requirements (although a central waste storage and control room is required).</p> <p>This option is likely to require high capital investment. Depending upon the level of maintenance requirements, this may result in operational savings.</p>	<p>Clear integration between chute and vacuum system must be demonstrated.</p> <p>Clear system maintenance responsibility demonstrated.</p>
Bin-fill telemetry	Bin fill sensors can be fitted to monitor when a wheeled bin is full and requires collection.	This can have some benefit to facilities management to monitor specific misuse issues. Where appropriate, full bins can be secured when full to prevent overflow.	Bin sensors adequately fixed to avoid issues with sensors being dislodged.
Material Stream Bag Colours	Colour coded bags used for different waste streams to aid contamination avoidance and better resident recycling.	<p>This allows facilities management staff to easily detect wrongly deposited bags within bulk bins at the bottom of chutes and, where safe to do so, redistribute waste to correct bins.</p> <p>Opportunity to integrate with future technology advances to automatically direct waste to correct bulk bin depending on bag colour.</p> <p>There is some capital investment required for provision of bags.</p>	<p>Clear user instructions provided on bags and communications.</p> <p>Consistency of bag colouring with OPDC/WCA material colour schemes.</p>

3.2.1.4

Public Realm Deposit Points

Residents are responsible for transferring recycling and waste to deposit points located within the public realm. These can be linked to a number of back end solutions such as underground waste collection systems or to an automated waste collection system e.g. vacuum system. From the perspective of the resident, how the waste is stored and collected once deposited is relatively immaterial and likely to be influenced by the overall waste strategy adopted by OPDC.

Requirements if Adopted

- Waste and recycling deposit point to be sited in a convenient location to allow for residents to easily access on the way to and from the building as part of normal day to day activity (i.e. avoid locating where residents must make a special trip).
- Deposit points for each material streams must be clustered together to allow residents to dispose of all waste streams at one location.
- Siting to consider mitigation of noise and odour issues for residents.
- Clear, consistent signage to be provided to indicate recycling and waste segregation requirements with colour coding consistent with that used within the home and elsewhere within development.
- Security of access and cleanliness of use can be improved with access columns being fitted with 'night-safe' style opening and foot pedal operation where hopper door is installed.
- Access to bins to be controlled with an ID-card or key fob system, either to open bin or access to residential courtyard area not accessed by the public.
- Clear maintenance schedule.

Good Practice

These public realm deposit points' examples from Tower Hamlets (top) and Wembley Park (bottom) both demonstrate clear labelling and consistent colour schemes with the rest of the development. Deposit points are clustered together and conveniently located for resident use.



	Advantages	Disadvantages
Technical Complexity	<ul style="list-style-type: none"> • System is well understood and fairly easy to install. 	<ul style="list-style-type: none"> • Installation of bins requires some limited ground works and civils. Location of bins needs to be planned to avoid services. • Life-span is between 10–15 years before replacement. • Access needs to be restricted to avoid bins being used for commercial waste.
Land Take	<ul style="list-style-type: none"> • Less land take for storage compared to above ground storage. 	<ul style="list-style-type: none"> • Less flexible in terms of siting as needs to be sited to allow direct access by collection vehicle lifting equipment.
Impact on WCA		<ul style="list-style-type: none"> • Requires non-standard collection vehicles to carry out collections.
Capital and Operational Costs	<ul style="list-style-type: none"> • Relatively low operational costs due to reduced facility management time required compared to bulk bin storage options. • No transfer from storage to collection point required. 	
Maximising Recycling	<ul style="list-style-type: none"> • Relatively clean public realm as waste stored underground. • High visibility of residents at point of disposal reduces anonymity and potential for performance improvements. • Ease of use at point of deposit. 	<ul style="list-style-type: none"> • Less convenient for residents than chute options.
Future Proof	<ul style="list-style-type: none"> • Ability to control access and record usage to the individual / household level through use of ID-card access where fitted. 	<ul style="list-style-type: none"> • Less flexible than above ground bulk bin storage in event that units need to be relocated or expanded. • Less flexible than above ground bulk bin storage in event that waste stream segregation requirements change in future.

System Options	Description	Relative Merits	Requirements
Underground Waste Collection	<p>Above ground deposit points feed directly into large underground storage containers (typically 5000l). A specially designed or modified collection vehicle collected waste collects material.</p> <p>There is a further option to install bin-fill telemetry to aid monitoring and collection.</p>	<p>Likely lower capital costs than other back end options.</p> <p>Relatively small containment volumes and therefore likely to require greater number of deposit points compared to other back end options.</p> <p>Potential for odour issues of separately collected food waste which may impact upon performance.</p>	<p>Must be accessible from a serviceable highway.</p>
Automated Waste Collection	<p>Above ground deposit points feed directly into an automated (vacuum) system. Waste is held within the tube of the disposal point from which, at periodic intervals, it is released into a vacuum system for transportation to a central storage room where material is held within bulk containers. Collections are made with a hook lift vehicle.</p>	<p>Low operating cost but high capital investment required.</p> <p>It is difficult to retrofit this system into a development and reconfigure to accommodate changes in WCA collection systems.</p> <p>Minimal risk of odour at deposit points.</p>	

Systems which were considered but not regarded as appropriate for this development, included:

- Door to Door collections – whilst replicating the service offered for kerbside street level properties, this system requires significant operational expenditure and resource that are unlikely to be met by WCA or management companies.
- Communal Bin Stores per Floor – whilst more convenient to residents than podium or basement level bin stores, a greater investment in space is required along with significant facilities management staff to move the waste from point to point within the building.

Door to Door collections in City of London

Waste and Recycling is deposited in 'waste cupboards' shared between two units and collected using caged trolley by site management. *Image Source: WRAP*



Collection from each floor

Waste and Recycling is deposited in 'waste cupboards' shared between two units and collected using caged trolley by site management. *Image Source: WRAP*



3.2.2

Calculating Waste Capacity Requirements

OPCD requires developers to calculate the waste and recycling storage capacity needed in the following way:

Step 1:

Calculate the volume of waste arising for each of the three material streams for which separate containment is required (i.e. food waste, DMR, residual waste) for the development for which provision is being provided based on the following formula: $A \times ((B \times C)) + 30$

Where:

A = number of dwellings

B = volume arising per bedroom⁸

1) 10l food waste

2) 32l DMR

3) 58l residual waste

C = average number of bedrooms

Step 2:

Calculate the number of bins required for each material stream using the following formula:

Material stream waste arising (litres) ÷ bin volumes
(1100l for DMR and refuse, 240l for food)

Step 3:

Use Table 3 2 to calculate bin store space requirements using the following formula:

(Number of bins x Total Area per Bin) + 2.989m²⁹

⁸ — This is based on the London Environment Strategy that anticipates that it is feasible to achieve 42-43% household recycling. The remaining gap to achieve the LACW target will have to be met by other non-household waste collection services.

⁹ — For each bin store and additional door operating allowance of 2.989m² should be added.

3.2.3 Plot Test Case Study

To assist developers understand the relative constraints of the infrastructure system options, a plot test case study was undertaken by OPDC. Developers are expected to show that a comparable assessment has been undertaken, and that this assessment provides evidence that the decision about the approach to waste management best meets OPDC's requirements and policies.

Table 3.3 shows the anticipated waste arising from the typical block case study using the guidance provided in 3.2.2. This informs the space required to deal with waste under the different approaches.

Table 3.2:
Bin Dimension Guidelines

	Bin Size	
	1100l	240l
Width (including 150mm between bins)	1.52m	0.727m
Depth (including 150mm between wall and bin, and 1m operating corridor)	2.235m	2.715m
Total Area Per Bin	3.972m ²	1.974m ²

Table 3.3:
Anticipated Waste Arisings from a Typical Block

Core No	Units	Bedrooms	Waste (l)	No. of 1100l Bins
01	28	56	6,440	6
02	207	377	43,910	44
03	24	36	4,320	4
04	30	50	5,900	6
05	30	64	7,300	8
06	37	88	9,910	10
07	52	122	13,760	14
Total	408	793	91,540	88

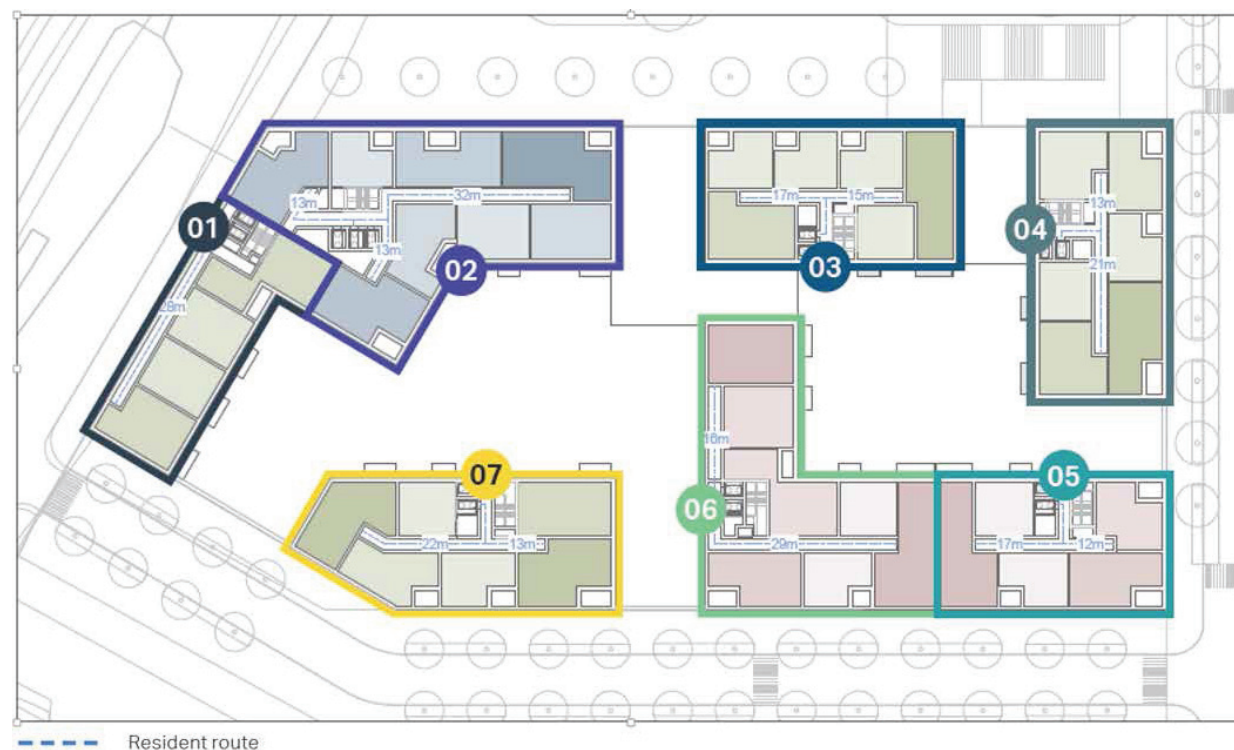
Figure 3.1 shows a typical residential level within a high rise dense mixed-use block. The blue dashed lines show the distance travelled by residents from each unit to the elevator shaft.

In this case, a chute based system, with the chutes located close to the elevator shaft and designed in using an adjacent shaft system, would, in all but one case in block 2, meet the requirement for residents to travel no more than 30m to deposit waste.

However, the following constraints would need to be considered:

- Storage space location – facilities would need to be designed into the building to allow collection and storage of waste at the bottom of the chute. The additional shaft space required for this option may impact on the design of lower levels, impacting on the total available residential and commercial space allocations.
- Storage space size – the size of storage space required at the base of the chute can be reduced to only accommodate 'in-use' and 'spare' bins. This would also have the advantage of minimising collection vehicle movements around the site. However, an additional central storage space(s) would be required to accommodate the total volumes of waste produced by the block/development. Including some form of compaction would further reduce the overall space required for waste management. Appropriate management capacity would be required to effectively manage this system.

Figure 3.1: Typical Level and Anticipated Waste Arising's



A conventional bin store system adopted in this case, would see bin stores located at the lowest level of each elevator shaft at either level 01 or 00 as shown in Figure 3.2 due to the varying levels associated with the site. This system would have limited impact on the configuration and space allocation though the levels of the building.

The following constraints would need to be considered, however:

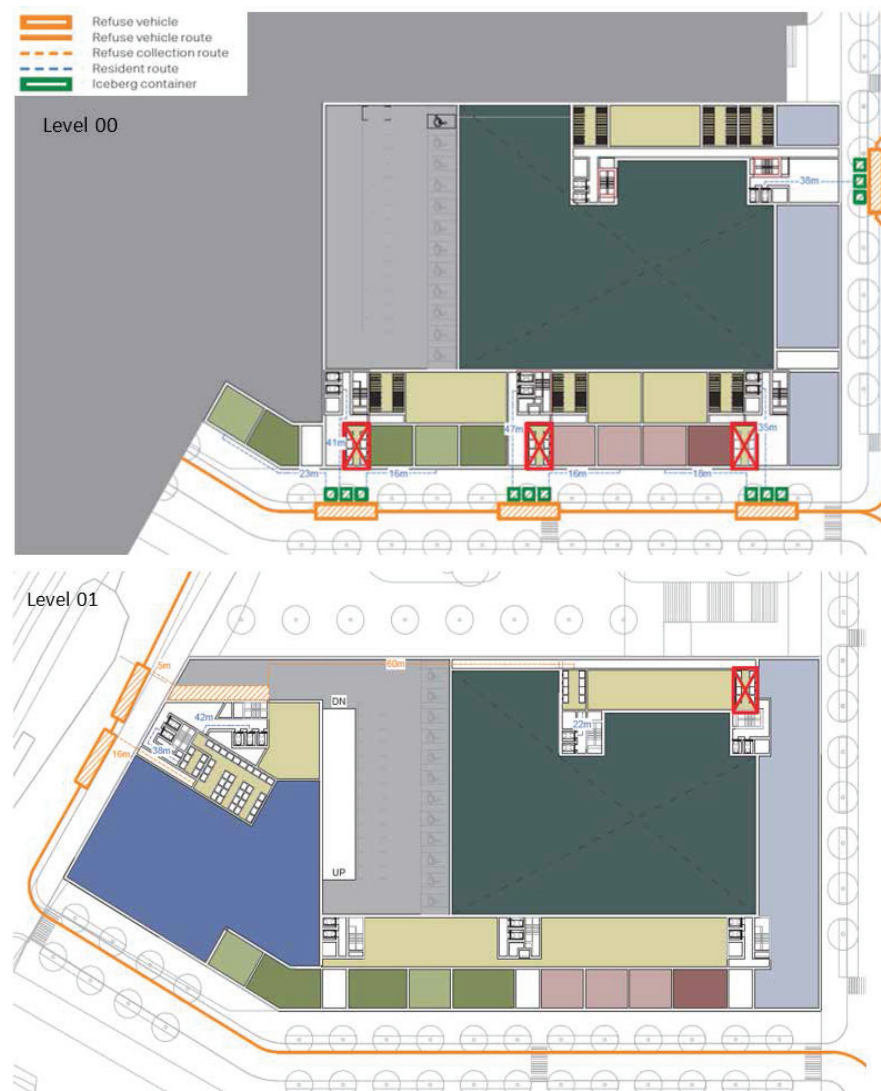
- Travel distance – in this example the distance travelled by a number of residents to reach the anticipated bin store locations, shown as maximum accumulated distance (distance travelled on both levels) from residential unit to bin store by blue dotted lines, exceeds the 30m which would not comply with OPDC's policies.
- Space requirements – in this case, it is anticipated that a total of approximately 300m² would be required to be allocated to bin store facilities. Centralised compactor skip facilities could be incorporated into the development to minimise bin store space and collection vehicle movements but this would need to be designed into the development and required dedicated management capacity to handle.
- Collection vehicle access – the distance from collection vehicles to bin stores is shown on Figure 3.2 by orange dotted lines. There are particular issues here with vehicle access with bin stores located on level 1. In two cases, bin stores are between 60m and 92m, failing to meet OPDC's requirements. Resolving this issue would require significant development reconfiguration.

Figure 3.2: Typical Block Travel and Vehicle Distances – Bin Stores



Developers are advised to consider the challenges and constraints highlighted in proposing an appropriate infrastructure system and are expected to demonstrate their rationale through similar plot testing and demonstration that the system will meet OPDC's overall requirements.

Figure 3.3: Typical Block Travel and Vehicle Distances – Public Realm Deposit Points



3.3 On-Site Food Waste Treatment

There are a range of technologies available which could be provided by developer / landlord at building scale.

The main types are:

- In-Vessel Composting (IVC) to produce compost-like-output soil improver;
- Anaerobic Digestion (AD) to produce digestate and biogas converted to electricity for use onsite via small-scale Combined Heat and Power (CHP) unit; and
- Aerobic Bio-Digester to sewer.

Aerobic bio-digestion, with the output disposed of to the sewer, is unproven in a domestic building setting and is considered inappropriate for Old Oak and Park Royal due to the already strained water and sewage system. Life-Cycle Analysis studies have suggested that AD is the preferred technology from an environmental point of view. There are examples of small AD units installed at a local level such as the Flexibuster by SEAB (see A.2.0).

However due to technical complexity, cost and economy of scale of AD, unless installed and managed on a large development scale, it is often not feasible at the building level. A full business case would be required for AD to be considered for inclusion within the Old Oak and Park Royal development. Provision would also be required within the overall development masterplan along with plans for collection and movement of food waste around the development.

There are some examples of IVC technology being used at a small-building-scale level in a residential setting (see A.2.0). The benefits and issues with small-scale IVC are set out below.

Benefits:

- Relatively good environmental performance compared to commercial facilities incorporating transport emissions.
- If output is used within development, particularly with resident involvement (e.g. community garden), encourages residents who are predisposed to being motivated in this way, to participate and encourage their peers to do so.

Issues to consider:

- Space considerations (units range from L 2.5m, W 0.7m, H 1.3m to 10m+, W 4m + H 3m+, not including working space and storage of feedstock and output)
- Staffing to operate and monitor equipment, load vessel and remove, screen and store output.
- Odour and H&S considerations – Siting in discreet building separate to residential area preferable
- Environmental Permitting – Will depend on unit capacity. May qualify for an exemption under Environmental Permitting Regulations (but registration still required).
- Supply of dry bulking agent – ideally there would be a local source of dry wood chippings of suitable specification to avoid having to import on to site.
- Compost outlet – There would need to be adequate outlet(s) for using soil conditioner output on site i.e. use on community or private gardens, development landscaping etc.

3.4 Bulky Waste

In addition to provision of recycling, food and reuse, developers are required to provide space for residents to deposit unwanted bulky household waste items (e.g. mattresses, carpets, sofas, beds and other furniture, large electrical and white goods). Developers are required to consider the following for bulky waste provision.

- A clearly signposted, secure deposit and storage area should be provided either within building service area or in a designated covered area within the development and within easy reach of building entry and access for collection vehicles (likely to be transit cage-tipper type).
- The space allocated to store bulky waste items should take into account the number of dwellings served and frequency of collection.
- Regular collection arrangements should be established with the WCA to avoid excessive build-up of waste and discourage fly-tipping.
- Where possible links to local re-use organisations should be established to maximise the amount of waste that is prepared for re-use and recycled. This should be strongly promoted to residents.
- Guidance should be issued to residents advising of the designated area for their bulky waste, what types of waste is and isn't accepted and what arrangements are in place for re-use and recycling.

4.0

Waste Management Strategy Options – Commercial

The high density, mixed use nature of the Old Oak and Park Royal development will generate large quantities of commercial waste, for which space needs to be provided.

To support the London Environment Strategy, it is expected that ~70% of commercial waste will need to be recycled. This is achievable based on evidence from other parts of the capital but will not happen without first identifying management arrangements.

For developers, the following principles are critical:

- Waste storage (bin store) space must be easily accessible;
- Sufficient waste storage space must be provided for each business;
- There must be sufficient space for each business to store multiple different types of bin (general waste, dry mixed recyclables, food and other streams depending on the business type).
- Commercial waste storage must be separate from residential waste storage.

The options available to developers for the provision of commercial waste facilities will be influenced by the overall commercial waste management strategy that OPDC choose to adopt.

- Market led approach: the standard approach to commercial waste management whereby commercial waste producers are responsible for their own waste service. In theory, market competition drives down price but in reality, the greater the competition, the greater the inefficiency per collection i.e. there is a minimum cost of collection which has to be covered so the fewer commercial waste contracts a contractor has, the higher the cost per collection is to cover minimum collection costs.

- Consolidated business approach: commercial waste producers are required to use the waste services provided by OPDC/management company, including waste collection contractor, through their lease agreement. This has many advantages including:
 - reduction of vehicle movements associated with multiple waste contractor collections;
 - potential costs saving associated with economy of scale in collection;
 - greater separation of waste streams that might otherwise be uneconomical to collect; and
 - potential to provide alternative solutions that move away from conventional bin store provision.

Where a single waste service contract is procured on behalf of several different businesses, then it is still necessary for the collector to know how much waste of what type is presented by each business in order to be able to charge appropriately and to ensure that the system is used correctly. The simplest way to achieve this is to use 1100 bins which can be allocated to individual businesses and weighed at the point of collection by on-board vehicle weighing equipment.

It is very likely therefore that whether a consolidated contract is put in place, or it is left to individual businesses to arrange for their waste to be collected in the standard way, space for several bins will need to be provided for each business.

Calculating Commercial Waste Storage Space

To be able to calculate the amount of space required for waste storage, one needs to know the number and type of businesses which are being provided for. This information is not available at the point at which this guide is being produced. Instead, therefore developers will need to use the following information to calculate the amount of bin storage space that will be required.

Step 1:

Tonnes per Annum (Table 4.1) ÷ Material Composition
(Error! Reference source not found.)
= Material Stream Tonnes per Annum.

Step 2:

Material Stream Tonnes per Annum ÷ 1000
= Material Stream kg per Annum.

Step 3:

Material Stream kg per Annum x Bulk Density
(Table 4.3) = Material Stream Litres per Annum.

The calculated Material Stream Litres per annum should be used by developers to calculate the number of bins required for commercial waste and subsequent storage space requirements, using guidance provided in section 0 that meet OPDC's key principles for commercial waste provision.

Table 4 1:
Waste Arising per Employee (tonnes/annum)

Business Sector	Number of Employees						
	0–4	5–9	10–19	20–49	50–99	100–249	250+
Retail & wholesale	3.08	17.23	25.37	56.32	137.94	292.42	820.25
Hotels & catering	1.67	14.50	21.87	47.48	92.42	95.64	782.97
Other services (e.g. Office)	1.05	4.27	6.76	25.27	60.50	40.19	416.89

Note:

Data on commercial waste arisings are limited, with the principal source being periodic surveys carried out by Defra. While this is far from being a perfect source, it is the best available starting point for an analysis. The last full-scale survey relates to 2008/09, and was published in 2010.¹⁰

While the headline results have since been updated, with overall arising falling by almost 20%, the key tables that show the quantity of waste arising in different industries and in businesses of various sizes have not been refreshed. Expected arising have therefore been scaled down from the 2010 results to reflect the reduction in waste that is believed to have occurred in intervening years.

Table 4.2:
Composition

Business Sector	Material Stream			
	Food Waste	DMR	Additional Separate Recyclables	Residual Waste
Accommodation and food service activities	31.9%	24.1%	27.5%	16.4%
Generic Commercial	3.6%	38.0%	30.7%	27.7%

¹⁰ — DEFRA (2010) Survey of Commercial and Industrial Waste Arisings 2010 - Final Results, 2010

Table 4.3:
Bulk Density

Waste Stream	Bulk Density (kg/L)
Residual	0.12
Residual (Low Food)	0.08
Mixed Recycling (with Glass)	0.08
Mixed Recycling (without Glass)	0.07
Food Waste	0.50
Garden Waste	0.32
Paper & Card	0.11
Paper	0.31
Glass	0.46
Cardboard	0.06
Card	0
Metals & Plastics	0.03
Metals	0.04
Steel	0.04
Ferrous Metal	0

Waste Stream	Bulk Density (kg/L)
Aluminium	0.04
Non-Ferrous Metal	0
Mixed Bottles and Mixed Plastics	0.02
Mixed Plastics Bottles	0.03
Dense Plastic	0
WEEE	0.21
Textiles	0.23

Sources:

- Review of Bulk Densities of Various Materials in Different Containment Systems, WRAP, 2007
- WRAP apportionment tool: <http://www.wrap.org.uk/la-apportionment>
- WRAP Material Bulk Densities, January 2010
- <https://www.sepa.org.uk/media/163323/uk-conversion-factors-for-waste.xlsx>

5.0

Decision Making

It is recommended that developers follow the following steps in developing an appropriate waste management strategy and demonstrate that OPDC's requirements and policies are met as a result.

Step 1:

Ensure waste sufficient storage space is provided for within each residential unit

Step 2:

Calculate both household and commercial waste arising associated with each block

Step 3:

Determine preferred approach to residential waste management based on options considered appropriate by OPDC that best meet policies and requirements set out within this guidance.

Step 4:

Demonstrate that appropriate residential waste management facilities have been designed into the development based on the preferred approach and that these will accommodate the volume of waste to be generated across Old Oak and Park Royal.

Step 5:

Where the preferred approach does not meet OPDC's minimum storage and travel distance requirements, show how waste will be transported, and how this has been accounted for and set out in development costs.

Step 6:

Show how bulky waste services have been included within the development.

Step 7:

Show where and how commercial waste facilities have been included in the development design.

Step 8:

Show how smart technology and innovation has been included within the preferred solutions which will aid recycling across the development. Developers should set out what impact these measures will have on management and maintenance.

Step 9:

Set out behaviour change and resident/commercial management approach.

6.0

Policy Recommendations

Development proposals for waste management should:

- Encourage high diversion away from refuse and increased recycling in both residential and commercial development.
- Provide sufficient waste storage within the home to allow separation of three waste streams; dry mixed recycling, food waste and residual waste;
- Exclude maceration technology from both residential and commercial units;
- Provide sufficient waste storage capacity within each residential block for at least one weeks' worth of storage of dry mixed recycling, food waste and residual waste;
- Provide residential waste infrastructure that
 - + Does not require residents to travel more than 30m (excluding vertical distance) from their residential unit to deposit point;
 - + Is within 25m of the collection point agreed with the relevant authority.
- As far as possible position waste deposit/collection points between the front door of apartments and the access points to the public realm to make waste disposal as easy as possible.
- Provide provision for bulky waste storage within each block;
- Provide sufficient commercial waste storage capacity that allows separation of at least mixed dry recycling, food waste, residual waste, and other major waste streams as appropriate;
- Have been consulted with relevant Waste Collection Authorities on proposed waste management solution.
- Systems should be flexible and consideration given to the possibility that legislation or local authority waste collection contracts will change over time and that the composition of the waste may change. Different waste streams may need to be collected and the absolute weight and balance of weight between existing waste streams will likely change.
- Where staff will be required to manage systems once these are installed, then there should be a clear plan for this and the approach to meeting staff costs understood and agreed so that systems are not installed which are not subsequently supported.
- Where software or other technology is deployed, it is essential that a plan for its use and maintenance is put in place and that the funding arrangements for this are considered in advance.
- Arrangements should be made to procure, manage and require the use of a single commercial waste management contract. This will require:
 - + An organisation to manage the procurement
 - + A management team to manage the contract
 - + Contractual arrangements to be put in place to require businesses to use the contract which has been provided.

This is a significant project which should be designed and scoped carefully but which is practical and will make a meaningful difference to the number of vehicle movements on site and the costs of commercial waste management.

7.0

Appendices

A.1.0

User Engagement Examples

This appendix provides examples of good and poor practice of use engagement principles set out in section 2.3. This is intended to aid developers and management provide effective use engagement that improve performance.

A.1.1 User Instructions

Good Practice Example

Royal Borough of Hammersmith and Fulham's leaflets shown in Figure A1-1 introduce the new service, explain what can and can't be recycled as well as how to use the scheme. There are also some FAQs and sources of further information. These materials use very simple, clear and bold design with appropriate use of graphics and iconography.

Figure A1-1: User Instruction Good Practice

Frequently asked questions

Q The Smart Bank is overflowing how do I get it emptied?
A Contact Cleaner Greener, they will arrange for the Smart Bank to be emptied within 24 hours.

Q Where can I take unwanted clothes and shoes?
A Unwanted clothes and shoes can be taken to your nearest textile bank, please contact Cleaner Greener.

Q What can I do with bulky rubbish, such as furniture, white goods and DIY waste?
A Ask your caretaking service or Cleaner Greener to arrange a special collection.

Q What can I do with small electrical items, such as kettles and hair dryers?
A Small electrical items can be taken to collection points in libraries and some council offices, please contact Cleaner Greener.

Contact details
Cleaner Greener
www.lbhf.gov.uk/flatsrecycling
Cleaner.greener@lbhf.gov.uk
020 8753 1100
Caretaking service
0800 996 1751

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Produced by Hammersmith, Tel: 020 8753 2225.
1107 Home Bag & Smart Bank

Recycling is now even easier!
h&f
a cleaner, greener borough

Your new recycling service: Bag and Smart Bank

recycle
for Hammersmith & Fulham

How to use your recycling service

- 1. Use your bag to store recycling in your flat.**
- 2. Take your bag to your nearest Smart Bank and empty your recycling.**
Keep your bag - it can be used again and again.
- 3. Dispose of your rubbish as normal.**

Nice save
Last year Hammersmith & Fulham residents saved £500,000 by recycling. Please keep up the good work and recycle as much as you can.

What can I recycle in the Smart Bank?

Top tips

- Flatten cardboard boxes.
- Rinse out bottles, jars and cartons, as waste food and liquid make items unpleasant to store and sort.
- Remove lids from bottles and cartons.
- Squash plastic bottles and cartons.
- Make sure that aerosol cans are empty.

Yes please

No thanks

Small appliances
Clothes and shoes
Food waste

A.1.1 User Instructions

Bad Practice Example

The user instruction leaflet shown in Figure A1-2 has a relatively adequate overall design, the recycling bin colour is identical for all material streams. It is not clear how residents are meant to determine in which bin each recyclable material should be placed. It is unclear if signage will be provided on the recycling banks themselves.

Figure A1-2: User Instruction Bad Practice

Communal flats – what can I recycle?

Please separate your recycling as shown below, and place in the communal recycling bins.

So that we can recycle your waste, it's important that the right items go in the right bins.

We now take cardboard

1

Paper and flattened cardboard

No unflattened cardboard, Tetra Pak, or plastic wrapping

2

Plastic bottles, tubs, trays and pots, cans, aerosols and foil (wash and squish)

No other metals, paint cans, plastic wrapping or bags

3

Glass bottles and jars

No drinking glasses, light bulbs, spectacles, plate glass, Pyrex or other heat treated glass

More information overleaf.

For more information:

www.stalbans.gov.uk/wasteandrecycling 01727 819285
wastemanagementservices@stalbens.gov.uk @StAlbansCouncil

Flats Recycling

Frequently Asked Questions

Recycling – why should I bother?

Recycling is good for the planet. The more we recycle, the fewer natural resources are used. Waste is also very expensive to dispose of. Every tonne that isn't recycled costs nearly £100 to dispose of. This means that local taxpayers are paying hundreds of thousands of pounds a year just to bury waste that could be recycled. Thank you very much for doing your bit to recycle more.

What can I recycle?

See overleaf.

What do I do if a recycling bin is full?

Please contact us and we will consider whether an additional or larger bin is needed. Details overleaf.

What should I do with large household items?

Furniture, electrical goods and other bulky items can be taken to a Household Waste Recycling Centre – see box below. Alternatively, you can arrange for a special collection – a fee applies. For more information, please get in touch – contact details are overleaf.

Thank you for recycling!

What do I do with Tetra Pak?

Please don't put Tetra Pak cartons in the household recycling. For places where you can recycle these, please go to www.wasteaware.org.uk, or call 0300 1234 051.

Household Waste Recycling Centres

Open every day except Christmas Day, Boxing Day and New Year's Day.

Dark Lane, Harpenden – 10am-6pm

Ronsons Way, St Albans – 8am-4pm (winter), 8am-6pm (summer)

Waterdale, A405, Bricket Wood – 8am-6pm.

Hertfordshire County Council may change opening times in January 2015. To check opening times visit: www.wasteaware.org.uk or call: 0300 1234 051.

More information overleaf.

St Albans City & District Council **amey** **WasteAware**
 City & District Council Reduce Reuse Recycle Recover

A.1.2 Signage and Iconography

Good Practice Examples

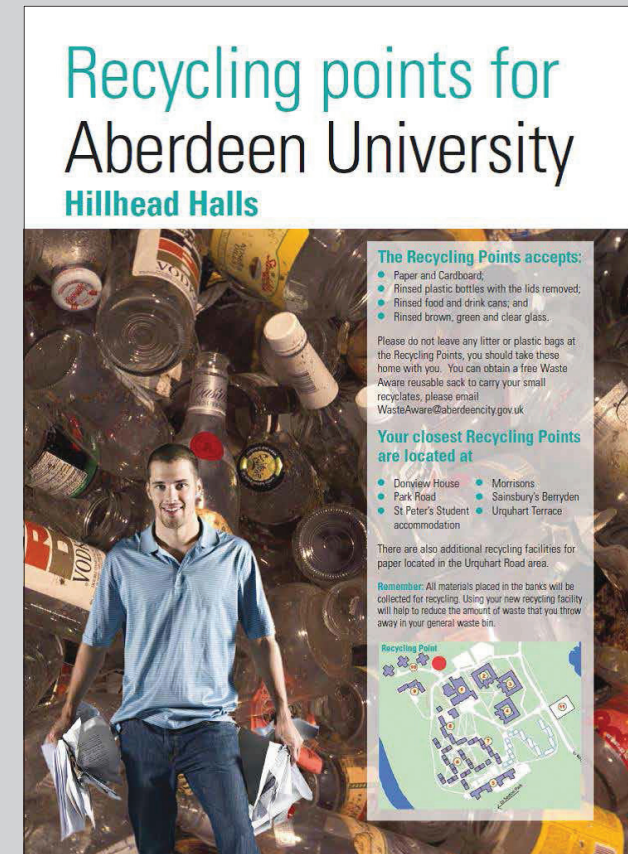
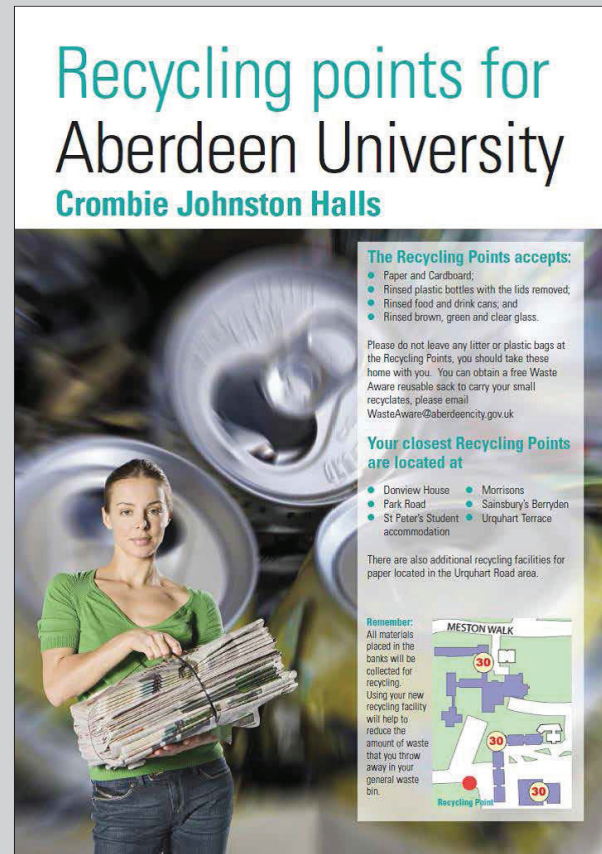
The poster shown in Figure A1-3 clearly show residents how to use recycling bags and mini banks, chute, and smart bank systems. There is clear and consistent signage used throughout which makes use of Recycle Now iconography. Each variant explains what can be recycled and how and shows what the facilities look like.

Figure A1-3: Signage and Iconography Good Practice



The posters shown in A1-4 show residents what can be recycled at their site, where the recycling points are (using a map) and also where there others nearby. An alternative approach is to leave a blank space to write in (or overprint) where the nearest recycling point is located.

Figure A1-4: Signage and Iconography Good Practice



A.1.3 Resident Communication

Good Practice Example

The leaflet shown in Figure A1-5 uses lots of imagery and few words as the audience may be multi-cultural. It provides detailed information on what goes in each bin, how to recycle, where the nearest bins are (and what they look like) as well as information on bulky waste.

Figure A1-5: Resident Communication Good Practice

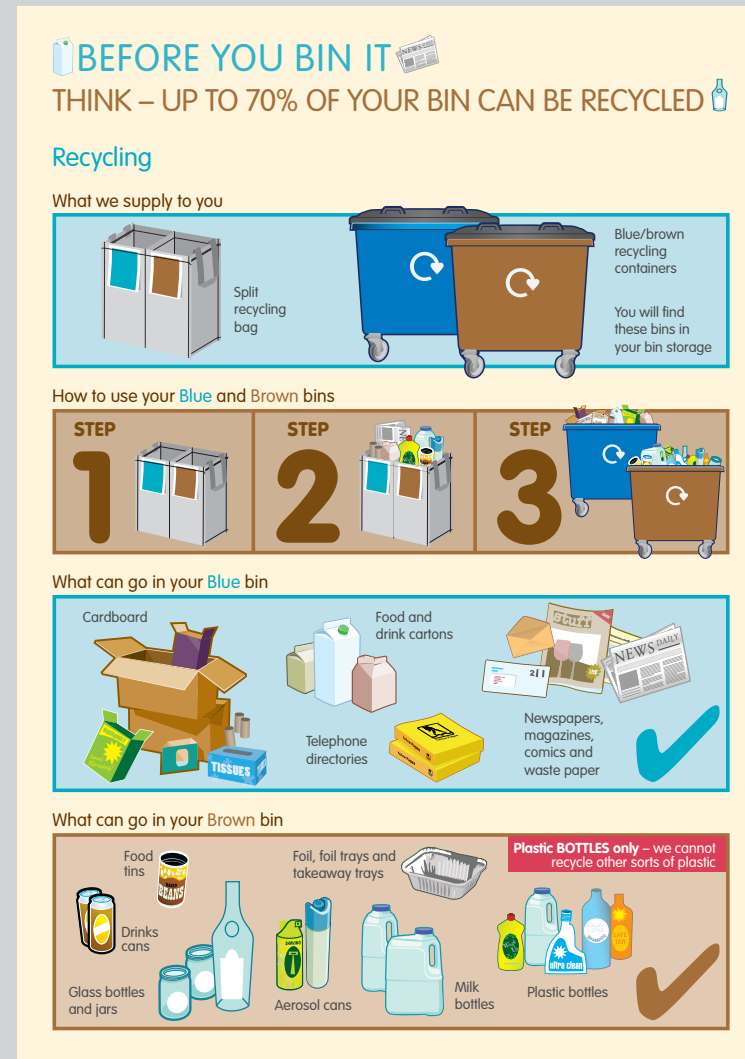


A.1.3 Resident Communication

Bad Practice Example

The below leaflet has a poor overall design and use of colour which confuses the different material stream. The iconography is not clear or consistent with text laid out poorly. Whilst the basic information is communicated, it is not engaging.

Figure A1-6: Resident Communication Bad Practice



A.1.4 Smart Technology

In 2016 Slough Borough Council and its environmental services provider Amey started trialling 'smart' recycling bins, shown in Figure A1-7, with the aim of reducing contamination. The bin is unlocked by the user's electronic key fob, restricted access to residents. The fact that the refuse bins are easier to access as they are closer to the bin store entrance and unlocked should mean only determined recyclers use the smart bin as it is more effort. Having a lockable recycling container also reduces 'casual' contamination by non-residents. Although this is an interesting example of the use of technology, it is normally preferable to make recycling no more complicated non-recycling disposal. By allowing users to access the residual waste bin without the key fob but requiring the use of a fob to recycle, it is likely that some recyclable waste will end up in the residual waste bin.

Figure A1-7: Smart Technology Good Practice – Slough BC Smart Bins



Figure A1-8¹¹ shows a trial 'pay as you throw (PAYT)' system in Porto, Portugal. Whilst PAYT is not permitted for residential waste in the UK which must be collected free of charge by the WCA¹², there are opportunity to replicate this technology for Business waste through a consolidate business approach.

In this example each user has a key card and can only access the recycling or residual containers through presenting the key card. The data management system then automatically bills each user dependent upon the number of times the residual waste container is opened. The technology is starting to be developed and trailed for use in a residential setting with data being used for enforcement and campaign targeting rather than charging.

Figure A1-8: Smart Technology Good Practice – Porto PAYT



11 — http://www.maiambiente.pt/documentos/4.2_LIPOR_PauloRodrigues.pdf

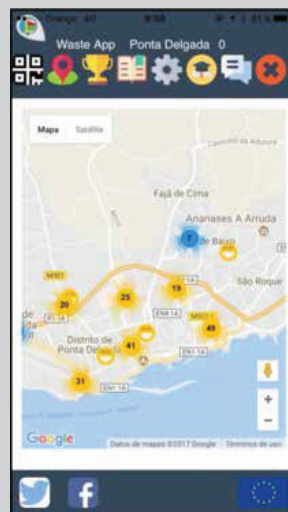
12 — Under the Environmental Protection Act 1990, s45, Local Authorities are required to collect household waste without charge. Authorities are, however, allowed to specify the type and number of waste containers that householders may use and a small number of authorities have used this flexibility to provide a basic service in small bins (or a limited number of sacks) free of charge and 'top-up' collections for additional waste for an additional charge. The legality of this approach is debated but has, to date, not been tested in court.

The Horizon2020 funded URBAN-WASTE project has developed WasteApp, which aims to "gamify" the management of waste, particularly in tourist destinations where many residents are not familiar with local segregation and collection systems; a situation which has been exacerbated by the rise of informal accommodation platforms such as Airbnb. It is currently being piloted in 11 pilot cities across Europe.

WasteApp uses a map of collection points marked with QR codes. When a user disposes of an item in the correct bin and logs the QR code, they are awarded points which can then be redeemed at local sponsors. The app also harnesses social media so that users can share this information and compete.

The app has only recently been launched, so it is too early to say how successful it will be but the H2020 backing means that an assessment and report will be forthcoming.

Figure A1-9: WasteApp Example



High-tech food recycling bins have led to a reduction in food waste production of around 10% in the South Korean capital Seoul. 10,000 containers installed across the city since 2011 have helped reduce household food waste by 30% and commercial food waste by 40%. The city saw a reduction of some 56,000 tonnes of food waste in the first half of 2017 compared to the same period last year, representing an annual reduction of 10%. The net benefit to the city is estimated at around \$8.8m.

The bins respond automatically to special ID cards when they are placed on a card reader. Each card is designated to a household, and the amount of food waste, calculated by the container, is registered to the household's monthly utility bill.

"In the past, people had to pay the same fee regardless of how much they disposed. With the new bins, people pay as much as they throw out, so they become more conscious in terms of minimizing food waste."

Sung-hyun Han, Manager of Environment Management Department, Seoul Metropolitan Government.

Figure A1-10: Communal Composting Stations with RFID Card-Readers. (image via Wikimedia Commons)



By the end of this year, Seoul is set to install 26-thousand more containers across the city, helping improve waste management for residents to live in a cleaner and more eco-friendly environment.

A.2.0

Food Waste Treatment Case Studies

A.2.1 Small Scale Anaerobic Digestion

SEAB on-site AD

A commercial bakery in the UK uses the SEAB's small scale onsite AD technology, Flexibuster. This is a small AD unit to create energy from its waste bakery products, generating electricity and heat which are used in the process, so that the investment pays for itself.

500kg of food waste consisting of sandwiches and breads is fed into the Flexibuster™ five days a week. This waste consists of old bread and old sandwiches with tomatoes, lettuce, mayonnaise, mustard as additional items, some cakes and sweet bakery items.

The bakery currently has a need for all of the electricity and heat that the unit can produce, and is currently buying this electricity at 0.14p/kWh, and 0.065p/kWh gas. With the unit producing more than 40,000 kWh of electricity and more than 70,000 kWh of heat, the bakery can save over £10K in current expenditures on energy.

The same commercial bakery has a waste disposal cost of £300/metric tonne. The waste being processed by the AD is reduced down to about a third of its initial tonnage, creating a cost savings of just under £14K per year in disposal charges. With local renewable energy support incentives available to the bakery, the capital cost, installation and maintenance costs can be paid off in under 5 years.

Figure A2-1: SEAB Flexibuster AD System

Image Source: SEAB



Figure A2-2: Example IVC System

Image Source: WRAP



A.2.2 In-vessel Composter Case Study

In-vessel composters (IVCs) are installed in nearly 50 out of 120 of Her Majesty's prisons. The technology used is available in a range of capacities and has a small footprint.

Food waste from the serveries and kitchen preparation waste is treated plus wood (sawdust or sawdust in pellet form). Plate waste is not usually included as it is difficult to collect. If the IVC has spare capacity, garden waste is added.

Typical waste processed per site per week is between 500kg to 1 tonne approx.

Treats all food waste captured, which represents around 70–80% of total food waste produced.

Capable of compliance with Animal By-Products Regulations and the British Standard for Composted Materials, PAS100.

Size ranges from 1.94 x 0.88 x 1.47 m to 6.32 x 2.2 x 2.32 m. For working and clear access an additional ~1.5m lengthways and widthways floor space e.g. T120 model = total of 13m². Approximately 500kg to 1 tonne of waste can be processed per week in a typical model.

Thank you.
